

## OPTIMIZING MEDICAL KITS FOR SPACEFLIGHT

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### INTRODUCTION

The Integrated Medical Model (IMM) is a probabilistic model that estimates medical-event occurrences and mission outcomes for different mission profiles. IMM-simulation outcomes describing the impact of medical events on the mission may be used to optimize the resource allocation in medical kits. Efficient allocation of medical resources, subject to stringent mass and volume constraints, is crucial to ensuring the best outcomes of in-flight medical events. We implemented a new approach to the medical kit optimization challenge that was first addressed by Minard et al. [1].

### METHODS

We approached the medical kit optimization as a modified knapsack problem and implemented an algorithm using a dynamic programming technique. Using this algorithm, optimized medical kits were generated for 3 different mission scenarios with the goal of minimizing the probability of evacuation and maximizing the Crew Health Index (CHI) for each mission, subject to mass and volume constraints. Simulation outcomes using these kits were also compared to outcomes using kits optimized using the approach described in Minard et al. [1].

### RESULTS

Under all optimization priorities, the medical kits generated by the algorithm described here resulted in predicted mission outcomes that more closely approached the best-case unlimited-resource scenario for CHI than did the kits generated by the algorithm implementation in Minard et al. [1]. Furthermore, the approach described here improves upon previous methods by reducing modeled evacuations when optimization priority is placed on minimizing the probability of evacuation. Typical results are shown in Figure 1.

### CONCLUSIONS

This algorithm provides an efficient means to objectively allocate medical resources for spaceflight missions using the Integrated Medical Model.

### REFERENCES

- [1] Minard CG, de Carvalho MF, Iyengar MS. (2011) *Aviat Space Environ Med* 82, 890-894.

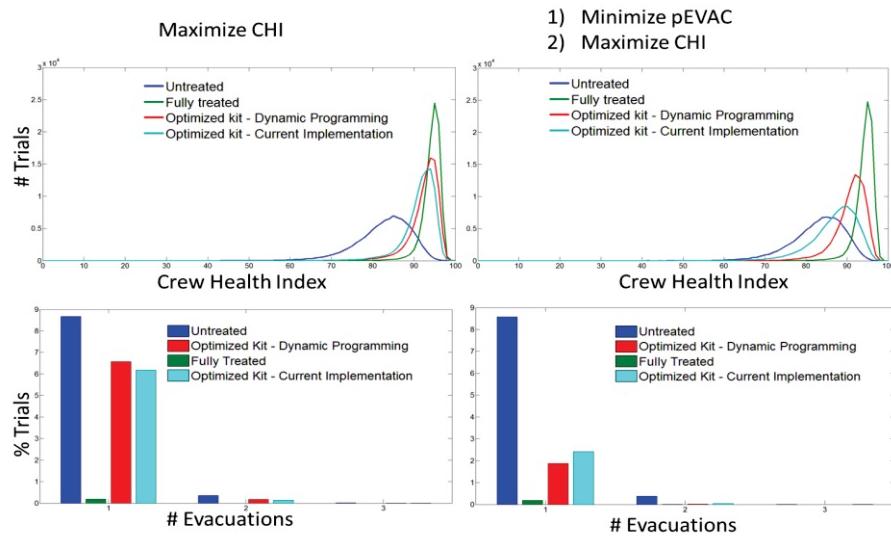


Figure 1. Optimized kit results for a 14 day, 4 crewmember mission. Left: Medical kits generated with an optimization priority of maximizing Crew Health Index (CHI). Right: Medical kits generated with a first optimization priority of minimizing the probability of evacuation and a second priority of maximizing CHI.